

Epidemiological Study Of Plantar Warts Among School Children

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AN EPIDEMIOLOGICAL STUDY of plantar warts among children attending the public schools in Dixon, Ill., was made by the school authorities and the Lee County Health Department during the school year 1951-52. The purposes of the study were (a) to determine whether or not an epidemic of plantar warts existed, and (b) to attempt to find significant factors in the epidemiology of plantar warts so that recommendations to prevent further spread might be made.

Despite the fact that plantar warts (*verruca plantaris*) are seen frequently in the general practice of medicine, relatively little has been written about them. The term plantar wart refers to any verruca located on the plantar surface of the feet. These warts may be single or multiple, multiple warts having either a haphazard distribution or that of a large wart with satellites (mother-daughter). The usual plantar wart is a hard yellowish or grayish lesion embedded in a small or large amount of hyperkeratotic tissue. On occasion the keratotic tissue may proliferate so freely that the lesion may be thought to be a callus. A diagnosis of verruca may be made if small black dots are found where the lesion is pared. These black dots represent vascular loops in the papillae of the corium and constitute the core of the wart.

Most plantar warts are presumed to have the same etiology as warts on other parts of

the body (*verruca vulgaris*) (1). When they grow on a pressure point of the sole of the foot, however, most growth must be inward. Severe pain and disability may result, particularly if the plantar fascia is invaded. Possibly of different etiology are the mosaic plantar warts, which are flat and nonpainful and which have irregular outline. Paring of these warts reveals many individual cores, forming a pattern which leads to the term "mosaic." Mosaic plantar warts frequently occur in association with hyperhidrosis (2).

Attack Rate

The feet of all children attending the public schools in Dixon were examined at weekly intervals during the school year 1951-52 by the school nurse and physical education instructors. In a school population of 2,389 students, 107 cases of plantar warts were discovered, an attack rate of 4.47 percent. For each of the 107 cases, an epidemiology card was prepared and filled out. A statistical analysis of the information obtained from these cards is given in table 1.

As a control measure, it was necessary to determine whether the attack rate in the Dixon schools was an epidemic rate. The school children in the neighboring town of Amboy were therefore examined in May 1952. In a school population of 275, only 2 cases of plantar warts were discovered, an attack rate of 0.72 percent. The two groups being comparable, a difference of 3.75 percent between the rates represents a standard error of difference of 0.6653 percent.

Table 1. Number of cases of plantar warts and attack rate among city school children in Dixon, Ill., by school, 1951-52

School	Number of students	Number of cases	Attack rate (percent)
Loveland (grade school) . .	128	4	3.13
Lincoln (grade school)	719	25	3.48
North Central (grade school).	469	16	3.84
South Central (grade school).	429	22	5.13
Dixon High School	644	40	6.21
All schools	2,389	107	4.47

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Table 2. Number of cases and attack rate of plantar warts among students in grades 4 through 8, according to availability of showers

School	Number of students	Number of cases	Attack rate (percent)
Showers available			
Lincoln.....	382	22	5.76
South Central.....	217	18	8.29
Both schools.....	599	40	6.67
Showers not available			
Loveland.....	38	4	10.53
North Central.....	293	16	5.46
Both schools.....	331	21	6.04

Thus, the difference is well outside the realm of chance, and it is assumed that an epidemic of plantar warts occurred among the school children in Dixon. It is realized, of course, that a year-long survey of the children in Amboy, such as was conducted in Dixon, might have yielded a greater number of cases and a higher attack rate.

Availability of Showers

No showers were available for the students in the North Central, the Loveland, and the first three grades of the Lincoln and South Central schools. Showers were available for the remainder of the students. A comparison of the number of cases and the attack rate of plantar warts among students taking showers with the number of cases and the attack rate among students not taking showers is shown below:

	Number of students	Number of cases	Attack rate (percent)
Showers not available....	1,146	27	2.35
Showers available.....	1,243	80	6.44

The factor of age, however, must be compensated for in interpreting these figures since all students not taking showers were in grade schools, whereas the students taking showers were in both grade and high schools. Therefore, a comparison was made between the two grade schools with shower facilities and the

two grade schools without shower facilities omitting the figures for the first three grades (table 2). A ratio of 0.38 exists between the difference in the attack rates for these two groups (0.63 percent) and its standard error (1.67 percent). Thus, the difference is so small in comparison with its standard error that showers are neither implicated nor absolved as a causative factor in the epidemic.

Both the Lincoln and South Central schools use foot baths and powderboxes in their shower rooms, and all showers and shower rooms are scrubbed nightly with a strong antiseptic solution. No statement can be made as to the effect that these preventive measures had on the attack rate since there was no group in Dixon with which to compare them.

Incidence by Sex and Age

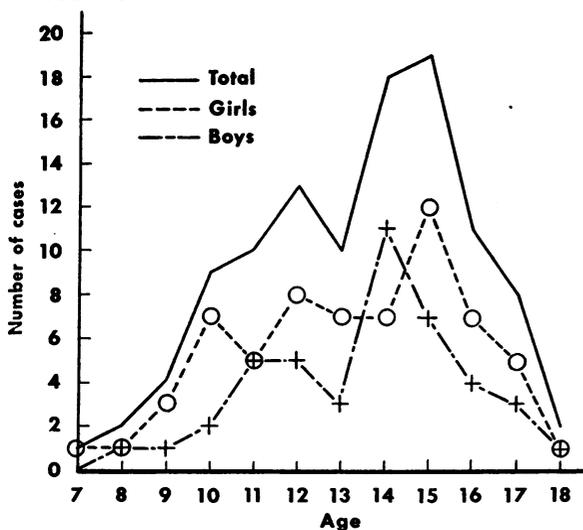
As shown in table 3, there was a higher incidence of plantar warts among girls than among boys: 59.8 percent of the cases occurred in girls. The difference between the attack rate for girls (3.48 percent) and for boys (5.55 percent), 2.07 percent, bears a ratio of 2.44 to its standard error, 0.88 percent. This difference could occur by chance only about 7.3 times in 1,000 and is therefore significant. Watkins also reported a higher incidence of plantar warts in girls, 62.9 percent (3). No reason for the higher incidence in girls has been determined.

The greatest number of cases for all students occurred at age 15; the greatest number for boys, at age 14, and for girls, at age 15 (see chart).

Table 3. Number of cases of plantar warts, by sex

School	Number of students		Number of cases	
	Boys	Girls	Boys	Girls
Dixon High School.....	303	341	16	24
Loveland.....	66	62	4	0
South Central.....	234	195	11	11
Lincoln.....	394	325	4	21
North Central.....	238	231	8	8
All schools.....	1,235	1,154	43	64

Distribution of cases of plantar warts among school children in Dixon, Ill., by sex and age, 1951-52.



The following tabulation shows the number of students observed in each grade:

Grade	Number of students
Kindergarten	271
1	177
2	161
3	234
4	180
5	184
6	171
7	173
8	170
9	213
10	188
11	150
12	117

Other Data

The number of cases of plantar warts discovered in each month of the school year 1951-52 were as follows:

Month	Number of cases
(Before July)	3
July	3
August	5
September	5
October	6
November	4
December	6
January	10
February	20
March	23
April	17
May	5

The epidemiological investigation also revealed the following data: All 107 of the students with plantar warts participated in physical education classes. Thirty-six of these students participated in interscholastic sports; 71 did not. Ninety-three of the 107 students swam in the Dixon swimming pool during the summer; 14 did not.

Incubation Period and Etiology

Investigators have attempted to determine the incubation period of verrucae vulgares through inoculation experiments on humans. They have found the incubation period to be 1 month, 3 months, 6 months, 8 months, and 20 months. The fact that material from verrucae injected into the normal skin will cause a wart to appear is presumptive evidence that warts are caused by an infectious agent, though no etiological agent has ever been isolated from a wart. Most investigators believe the agent is a virus (1).

As a part of this study a number of specimens of plantar warts were removed surgically and sent to the University of Michigan Virus Laboratory for study. All efforts to isolate a virus proved unsuccessful.

Type of Warts and Location

No mosaic plantar warts were found. Seventy-nine students had single plantar warts; 28 had multiple warts. One interesting fact was that 11 students had verrucae on other parts of their bodies. The distribution of these lesions were: hands, 7; arms, 3; and knee, 1. The incidence of verrucae on the body among the general school population was not determined. However, the fact that 10.28 percent of the children having plantar warts had verrucae on other parts of the body, 91 percent on parts that probably would come in contact with the feet, appears significant.

Ninety-three of the 107 patients had one or more verrucae located on a pressure point—base of heel, longitudinal arch, metatarsal arch, or base of toes. This figure is considered significant. Many investigators have previously presented the theory that trauma is a significant factor in the etiology of plantar warts. The locations on the feet were: metatarsal arch,

Table 4. Incidence of plantar warts among other members of the families of children having plantar warts and of control group

Group	Number of letters returned	Number of families having other members with warts	Attack rate (percent)
Families of children with plantar warts	30	7	23.3
Families of children without plantar warts	22	5	22.7

55; toes, 28; heel, 18; longitudinal arch, 6; and other parts of the foot, 11. (The total of 118 is due to the fact that some children had warts on several parts of their feet.) There were approximately an equal number of warts on the right and left feet.

Family Members Having Warts

Since plantar warts and verrucae vulgares are presumed to be infectious, the incidence of warts among other members of the family was investigated. A form letter was mailed to the parents of each student who had plantar warts, requesting that the feet and body of each family member be examined for warts. As a control measure, letters were also sent to an equal number of parents of school children not having plantar warts. The children in the control groups were of the same age and sex and in the same schools as the children with plantar warts. The results of this investigation are shown in table 4. There does not appear to be a significant difference in incidence between the families of the patients and the families of the controls.

Summary

During the school year 1951-52, 4.47 percent of the students in the Dixon public schools were discovered to have plantar warts. An examination of the school children in the neighboring town of Amboy in May 1952 revealed an attack rate of only 0.72 percent.

A comparison of schools where showers were not taken with schools where showers were taken

(and foot baths and powderboxes utilized) failed to reveal a significant difference in the attack rates.

Girls showed a higher incidence of plantar warts than boys. The greatest number of cases in boys occurred at age 14; in girls, at age 15.

The incubation period was not determined; the greatest number of cases, however, had their onset in February, March, and April.

Seventy-nine students had single plantar warts; 28 had multiple warts. Eleven of these students had verrucae on other parts of the body. The percentage of school children having verrucae on other parts of the body was not determined, but the fact that 10.28 percent of the children with plantar warts had warts on other parts of the body is considered to be significant.

Pressure points were the site of 86.7 percent of the plantar warts. Since trauma would most likely occur on a pressure point, trauma may be a factor in the development of a plantar wart, as has been suggested by many investigators.

Plantar warts are thought by the authors to be related to verrucae vulgares. Many investigators have shown that material from verrucae can be inoculated into the skin of the same person or other persons and produce verrucae, suggesting that warts are infectious. The University of Michigan Virus Laboratory was unable to isolate a virus from specimens of plantar warts sent to them during this study.

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REFERENCES

- (1) Van Rooyen, C. E., and Rhodes, A. J.: *Virus diseases of man*. New York, Thomas Nelson and Sons, 1948. 1202 pp.
- (2) Montgomery, A. H., and Montgomery, R. M.: Mosaic type of plantar wart. *Arch. Dermat. & Syph.* 57: 397-399 (1948).
- (3) Watkins, M.: Plantar warts in school children. *M. Officer* 79: 198-199 (1948).